Fluctuations in perceived energy and mood among patients with chronic fatigue syndrome

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Summary

Patients currently suffering or recently recovered from chronic fatigue syndrome (CFS) were compared with each other and with a group of well-matched controls in a study of diurnal variation in levels of perceived mental and physical energy and positive and negative affect.

Patients who were currently ill showed diurnal variation in patterns of energy, with maximum levels being recorded between 10.00 h and 12.00 h which were significantly higher ($P<0.05$) than energy levels recorded on rising or retiring. This pattern was similar to the controls but average energy levels at each time point were lower ($P<0.05$) among the ill patients. Recovered patients showed the same pattern, with mean energy levels falling between those of the ill patients and controls. Similar diurnal patterns were found for perceptions of positive, though not negative affect.

Correlations between physical and mental energy and between both of these energy variables and positive affect were high ($r=0.75$ to 0.85) in both controls and CFS patients. However, correlations with negative affect were low (eg $r=-0.10$) and non-significant.

Total scores on the Hospital Anxiety and Depression Scale (HAD) were significantly higher ($P<0.05$) among patients who were still ill than those who had recovered. Scores on the HAD Depression (but not Anxiety) subscale were also significantly higher among those who were still ill ($P<0.01$).

These findings may be of value in facilitating programmes of cognitive-behavioural modification intended to aid the recovery of patients with CFS.

Introduction

Chronic fatigue is one of the most frequent causes of consultation in general practice[1]. Chronic fatigue syndrome (CFS) is defined as fatigue lasting for more than 6 months, associated with significant disability, for which causes other than a primary viral infection have been excluded. Because of its suspected viral aetiology, CFS is becoming an increasingly frequent presentation seen by specialists in infectious disease. However, since evidence linking the fatigue syndrome with the continuing presence of viral material in the patient's blood, stool or muscle has been found in only a minority of cases[2,3] current thinking does not require the presence of a viral aetiology in defining the syndrome[4].

Although patients with CFS frequently describe a global sense of profound and overwhelming fatigue, often associated with a dysphoric or depressed mood, no published studies appear to have investigated whether these perceptions of low energy and mood are constant or whether they show fluctuations during the course of the day. There appears to be only one published study that has tried to separate the patient's perceived mental and physical symptoms[5]. In contrast, a number of studies have described diurnal fluctuations in perceptions of energy or arousal and mood among healthy individuals, recording maximum levels of both at particular times of day.

Wood and co-workers[6] have devised a series of visual analogue scales designed to assess such diurnal fluctuations in self-perceived energy. They are simple to use and give reliable results. A major purpose of the current study is to investigate whether perceived energy states in patients with CFS are uniformly low or whether they also show diurnal variations. The use of such visual analogue scales should prove to be a useful adjunct, both to studying the progression of the disease and in initiating and following the results of any therapeutic intervention[7].

Earlier results in healthy volunteers have also found a close association between energy levels and mood states, with perceptions of physical and mental energy and positive (though not negative) mood being highly correlated[6]. Such mood measurements were therefore included in the present study, in which patients with chronic fatigue were compared to a control group of healthy students from the Open University. Some preliminary data on both groups have already been reported[8].

Finally, it was of particular interest to establish whether these various energy and mood parameters differed between patients who were currently ill and those who had subsequently recovered from the syndrome. The time lag between the patients' initial diagnoses and their recruitment for this study (at least one year) gave an opportunity to compare patients still complaining of illness with those who declared themselves to have subsequently recovered.

Subjects and methods

Patients and controls

All the patients in this study had been referred to the local regional infectious disease clinic during the previous 5 years with a principal complaint of fatigue for which no cause could be found other than a preceding infection in some cases. Approximately 18 months before the present study, a group of 144 patients had answered an extensive questionnaire including the 14-item Hospital Anxiety and Depression Scale (HAD)[9].

The majority of these patients subsequently received a letter inviting them to take part in a study of

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how energy levels change over the course of a day, and from one day to the next. They were also told that they were eligible to participate whether they had since recovered or not. Of the 88 replies received, 71 expressed their willingness to be involved.

These 88 respondents then received a follow-up letter containing a number of psychometric scales, the results of which will be reported separately. A total of 61 completed and returned these scales. Telephone invitations were extended to 41, all of whom agreed to attend, although four failed to keep the appointment because of practical difficulties. The final sample of 37 interviewed patients therefore represents some 42% of those who replied to the initial invitation. Whilst they do not represent a random sub-sample of the original group, they are nonetheless representative of patients with CFS, since all had satisfied, either currently or at some time in the past 5 years, the most recently accepted criteria for chronic fatigue syndrome[4].

Patients underwent a structured interview relating to their symptom patterns, their subjective experience of the illness and its effect on their functional capacity. The interview established whether the patient was currently feeling completely better, almost completely better, partly better or as ill as ever. In subsequent analyses, patients giving the first two replies were grouped together as 'recovered'. Those in the latter two categories were defined as being 'still unwell'.

Following this structured interview (the results of which will also be presented elsewhere) all patients were presented with a book of visual analogue scales[6,8] to assess their levels of self-perceived physical and mental energy. Scales ran from zero ('I have no energy at all') to 100 ('I am full of energy'). The scales also assessed the patient's positive affect by rating the extent to which they felt alert, excited and enthusiastic. Negative affect was similarly assessed by rating the extent to which they felt upset, nervous and irritated.

Each patient was made fully familiar with the use of the scales during the interview. Then they received an 'energy diary' containing 42 pages (scales to be completed 6 times daily for 7 days) with written instructions for completion. In addition, patients received a copy of the 14-item HAD[9] to be completed at the end of the week in question. Patients were asked to mail these documents back to the investigator at the beginning of the following week. All 37 did so.

All patients gave informed verbal consent to all stages of the investigation, which received the approval of the local Ethical Committee.

Control subjects were recruited from a class attending an Open University Summer School on Psychology. They had the visual analogue format explained and took away the materials to complete during the following week. Of a total of 24 attending the seminar, complete replies were received from 20 (83%).

Instruments

Visual analogue ratings of physical (PE) and mental (ME) energy

The visual analogue format has been verified against the adjectival format of the Profile of Mood States, and its reliability established from 'split-half' studies on a pilot population[6]. The scales, which are divided into five unit intervals, are anchored at 0 and 100. Participants put a circle round the number which best describes their level of physical (PE) or mental (ME) energy at that moment.

Positive and negative affect (PA and NA)

Levels of positive affect (PA) and negative affect (NA) were measured at the same time points as physical and mental energy using a modified version of the 20-item Positive and Negative Affectivity Schedule (PANAS)[10]. Using a step-wise multiple regression analysis, Wood and colleagues subsequently reduced each scale to three items (alert, excited and enthusiastic for positive affect; upset, nervous and irritated for negative affect) and converted the scoring procedure from the original 1-5 ranking to a visual analogue format[8]. Total scores on positive and negative affect represent the sum of each of the individual items measured at each time point.

HAD scale

The Hospital Anxiety and Depression Scale of Zigmond and Snaith[9] is a widely used measure of affective disturbance. The scale is scored on a 0-3 format. It gives a measure of overall psychological distress and has separate sub-scales for anxiety and depression. The authors give a score of 8-10 for borderline and beyond 10 for a definite 'case' of clinical anxiety or depression. This scale was completed by 28 of the 37 patients who completed the other measures.

Analysis

A three-way analyses of variance with repeated measures was used to determine diurnal and daily variations *within* the three groups (Open University controls, recovered and unwell patients) and comparisons were also made *between* the three groups. The two 'within-subject' main effects were time of day and day of week, whilst the one 'between-subject' main effect was group. Significant F values for main effects were subsequently tested using the Newman-Keuls procedure to determine those paired comparisons that were significant. An additional analysis was performed to determine the within-subject correlations for the variables PE, ME, PA and NA. These were established firstly by calculating Spearman-rho correlations for each subject on each of the eight measures. The mean was then taken from these individual correlational values to produce an 8×8 correlational matrix. Such calculation of within-subject differences follows the original procedure of Watson *et al.*[10], and Clarke and Watson[11].

Results

Patient groups

All three groups of patients (recovered, unwell and controls) were found to be well matched in terms of age and sex with no significant difference between them on either of these parameters (Table 1).

Daily and diurnal variation in energy levels

The three way analysis of variance with repeated measures showed no significant main effect for day of the week. Thus, chronic fatigue patients show no more day to day variation in energy levels over the course of a week than do healthy controls. However, time of day as a main effect was significant for both physical and mental energy ($P<0.05$).

Table 1. Comparison of Open University controls with recovered and unwell chronic fatigue patients in terms of age and sex

	Open University	*Recovered*	*Unwell*
Number	20	14	23
F : M*	13 : 7	11 : 3	19 : 4
Age (mean±SD)†	43.5±6.3	45.3±10.6	46.3±12.9
Age (range)	28-53	32-74	27-75

*χ^2=1.80; P=0.41
†ANOVA Age×Group F=0.39; P=0.68

Table 2. Diurnal variations in mean levels of physical and mental energy (visual analogue ratings) at different time points in the day (mean of 7 days) comparing Open University controls with recovered and unwell chronic fatigue patients

	Time 1 (on rising)	*Time 2 (10.00-12.00 h)*	*Time 6 (bedtime)*
Physical energy			
Open University	48.9*	68.8*	48.9
	(17.3)	(9.5)	(18.2)
Recovered	35.1	52.3†	34.1
	(16.1)	(23.8)	(20.6)
Unwell	28.7	46.7*	29.9
	(19.7)	(16.8)	(14.6)
Mental energy			
Open University	52.5	73.9*	53.1
	(15.5)	(10.0)	(13.8)
Recovered	40.3	57.5†	39.6
	(16.7)	(24.0)	(19.5)
Unwell	33.6	53.0*	34.0
	(18.0)	(14.5)	(13.8)

Figures in parentheses are standard deviations
*Time 2 significantly different from times 1 and 6 ($P<0.05$)
†Time 2 significantly different from time 6 ($P<0.05$)

Energy levels recorded on rising, at mid-morning and on retiring are shown in Table 2. All three groups showed a similar pattern of diurnal variation, with the highest level of both physical and mental energy occurring at the second time point of the day, between 10.00 h and 12.00 h. Analysis using the Newman-Keuls procedure showed that energy levels at time 2 were significantly higher ($P<0.05$) than those recorded at time 1 (on rising) or time 6 (on retiring) in the unwell group and the controls. For the recovered patients, the pattern was also similar but the difference between times 1 and 2 was not significant.

Recovered patients were found to have lower energy levels (mental and physical) than controls at all six time points. (For simplicity, only three points are included in Table 2). 'Peak' energy levels (measured at time 2) were significantly lower among the recovered than the controls ($P<0.05$). For patients who were still unwell, the levels at each time point were lower still, and all values were significantly lower ($P<0.05$) than the controls. Thus, both groups of patients experience lower levels of both physical and mental energy than healthy controls throughout the day. Their diurnal energy curves do follow a similar pattern to those of normal individuals, but are shifted downwards overall. This downwards shift is greatest for patients who are still unwell, with recovered patients showing intermediate values. Differences between the recovered and unwell group, though consistent, were not significant.

Diurnal variation in mood

Analysis of variance with repeated measures showed time of day to have a significant main effect ($P<0.001$) for all three components of positive affect in all three groups, with values reaching maximum levels at time 2. Newman-Keuls analysis showed that for each component, levels at time 2 (mid-morning) were significantly greater than at time 6 (on retiring; <0.05) and frequently also significantly exceeded values measured at time 1 (on rising).

For each component of positive affect, values at each time point in the control group were greater than in the group who had recovered, and these in turn were greater than for those patients who were still unwell. Thus, diurnal changes in positive mood closely followed those seen for physical and mental energy for all three groups, with the same downward shift in positive affect for chronic fatigue patients compared to normal controls.

In contrast, negative affect showed no significant diurnal variation in any of the three groups.

Relationship between energy and mood variables

Spearman-rho correlations between physical and mental energy, and between both of these variables and positive and negative affect were measured as 'within-subject' variables. The correlations between physical and mental energy were high, ($\geqslant 0.75$) in all three groups. The similarity in the pattern of diurnal fluctuation in energy and positive mood was also reflected in the high levels of correlation between physical or mental energy and positive affect ($r \geqslant 0.75$) in all three groups. In marked contrast, neither physical nor mental energy correlated highly with negative affect and positive and negative affect were also largely independent of each other (eg $r=-0.01$ in the control group).

HAD scores

Total scores on the Hospital Anxiety and Depression Scale and on the Anxiety and Depression Sub-scales are given in Table 3. The unwell patients had a significantly higher total HAD level ($P<0.05$) than those who had recovered. They also showed significantly greater levels of depression ($P<0.01$) and higher anxiety, although this latter difference is not significant.

Table 3. Total HAD Scores and scores on HAD Anxiety and Depression subscales together with number of borderline and definite cases of depression and anxiety in recovered and unwell chronic fatigue patients

HAD score		*Recovered (n=9)*	*Unwell (n=19)*	P
Total (mean±SD)		8.8±6.9	13.4±4.8	<0.05
Depression (mean±SD)		3.1±3.3	6.2±2.7	<0.01
Anxiety (mean±SD)		5.7±3.9	7.3±3.4	NS
Depression score	(8-10)*	0	5	
	(>10)†	1	1	
Anxiety score	(8-10)*	0	4	
	(>10)†	1	3	

*Borderline case
†Definite case of depression or anxiety

In addition, the unwell group also contain a higher proportion of patients who are borderline or definite cases of clinical depression or anxiety according to the usual criteria by which the HAD is interpreted[9].

Discussion

Compared to a group of well-matched controls, patients currently suffering from the chronic fatigue syndrome have significantly ($P<0.05$) lower average levels of physical and mental energy at each time point of the day. Recovered patients have intermediate levels of physical and mental energy. The pattern of diurnal variation in both of these patient groups is similar to that in the controls, with the rise to the highest energy level of the day being achieved between waking and noon.

The fact that fatigued patients still retain this underlying diurnal energy pattern, albeit at a reduced level, may have some significance in treating such individuals, many of whom believe that they have 'no energy' at any time of the day. The therapist may be able to demonstrate that there are times in the day in which both their physical and mental energy levels show an increase. A policy of time management, such that the more arduous tasks of the day are scheduled for and performed at these 'peak' energy times may help patients to achieve some of their daily goals and prevent the avoidance of activity that is believed to be a feature of this condition[12].

Perceptions of physical and mental energy among both recovered and unwell patients show other comparable correlations to that of the control group ($r=0.77$). Mean correlations between physical and mental energy and positive affect in both patient groups are also comparable to those in the control group ($r=0.75$-0.85). In contrast, correlations between physical or mental energy and negative affect are low and non-significant, and positive and negative affect are themselves virtually uncorrelated (eg $r=-0.10$ in the Open University controls).

The reason why negative affect is independent of both positive affect and perceptions of energy is discussed elsewhere[8]. It seems that factors inducing negative affect are largely external to the subject and may be encountered at random times during the day. Positive affect, however, appears to involve an 'endogenous' component that follows the same diurnal cycle as perceptions of energy. It is part of a more general affective state popularly described as 'feeling good'. The independence of average levels of positive and negative affect is not therefore as surprising as it appears at first sight, and has been reported by several other authors[10,13,14].

Table 3 shows that unwell patients had significantly higher scores on the total HAD scale ($P<0.05$) and on the depression scale of the HAD ($P<0.01$). They also have higher levels of anxiety, but here the difference is not significant. In addition, the unwell patient group contains about three times as many borderline or definite cases of depression or anxiety.

Patients still suffering from chronic fatigue syndrome therefore show significantly more emotional distress than those who have subsequently recovered. Their higher levels of depression serve to reinforce the now widely current notion that such patients may be suffering from a depressive illness, of which physical fatigue is a somatic manifestation[15,16]. However, energy and mood levels among the fatigued patients are highest at mid-morning, as they are in recovered patients and controls, whilst the mood of typically depressed patients is lowest in the morning, only rising (if at all) later in the day.

The use of simple visual analogue scales to follow diurnal changes in mood may be of value in helping to resolve this question about the role of depression (either primary or secondary) in chronic fatigue. Similar monitoring of daily energy levels may also give an added measure of effectiveness to cognitive-behavioural programmes designed to aid the patient's recovery.

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